The results given are very meagre, and are as follows:—The efficiencies varied between 53 per cent. and 69 per cent. The thrust fell off in flight about 33 per cent. from the value with the aëroplane anchored. The rotational speed of the engine increased in flight from 0 per cent. to 15 per cent. above the speed with the aëroplane anchored, depending on the propeller. The experiments are to be continued with the aid of a further grant, and we may therefore expect more complete results of tests with the addition of more particulars of the propellers tested than are given in the present article.

It is to be hoped that the experimenters may improve the accuracy of their apparatus, so that their results may be of real scientific value, and not merely for the purpose of differentiating between a good propeller and a bad one.

FRANCIS H. BRAMWELL.

PHOTOGRAPHY IN SURVEYING.

FOR the last half a century continued efforts have been made to utilise photography in the preparation of accurate plans of country, and thereby economise some of the time expended in the detailed measurement of every feature and object. A photographic negative provides an accurate record of the area included in it, contains much detail which measurement alone cannot give, and is always available for future reference. On the other hand, the employment of photography requires certain technical knowledge, and a good judgment in the selection of stations and views; it is best suited to regions of considerable relief, but even then patches of ground are liable to be omitted altogether from the views, and such omissions are not recognised until the work is plotted; lastly, it necessitates considerable skill in the drawing office to get the best and most complete results from the field-work. Photogrammetry has, therefore, developed most rapidly in countries where mountainous districts offer favourable conditions for its employment, and where the season available for field-work is limited. France, Italy, Germany, Austria, Switzerland, and Canada have all made use of this method in topographical surveys, despite its drawbacks. Mr. A. O. Wheeler[1] describes in general terms the methods which are employed in Canada under the direction of Dr. Deville, the Surveyor-General of Dominion Lands, and employed by Mr. Wheeler on Dr. Longstaff's recent expedition in British Columbia. But the labour involved in utilising the information collected by the camera has always hindered its wider employment in surveying, so that we welcome a new method of automatically reproducing it on a plane surface, which is described by Prof. E. Brückner.[2]

Some years ago Dr. C. Pulfrich, of the firm of Carl Zeiss, of Jena, produced his stereomicrometer, by which the coordinates of points represented on a pair of stereographic plates were determined, and their positions defined, so that they could be plotted on a plan. In this instrument the plates are fixed, and the movements of the index pointers are measured. A further development was the stereocomparator, in which the plates are movable, and the points to be measured are brought under fixed marks, in this case the objectives of a stereoscope. By suitable mechanical arrangements the coordinates of any point on the picture and the stereoscopic parallax are readily determined, thus providing the necessary information for plotting the point measured. Lieut. von Orel, of the Military Geographical Institute in Vienna, conceived the idea of automatically recording the data thus measured, and the necessary modifications have been made to the stereocomparator so as to enable the data to be plotted mechanically on a sheet of paper. This instrument is called the stereoautograph, and in it the movements of the plates and the stereoscope of the stereocomparator are communicated to flat rulers resting on the drawing-board, and by their aid the positions of points are plotted on the plan. Not only is the horizontal projection of the detail effected in this way, but contour lines representing the relief can also be drawn.

Plans on a scale of 1:25,000 can be accurately produced in this way, and even one on the scale of 1:10,000 showed but slight differences from a precise measured survey of the same on this scale. The apparatus is said to be capable of producing a map sheet 35 cm. by 25 cm. of a mountainous region to the scale of 1:25,000 in about ten days' work, so that it promises to be of great value in reproducing the work of travellers and explorers who will take the necessary photographs. Photogrammetric methods do not apply where surveying is organised so as to utilise a *personnel* of moderate technical ability, where each individual carries out a single stage of the work only; but where skilled technical assistance is available, and each surveyor executes as complete a survey as possible of a given area, then stereophotogrammetry, simplified by Lieut. von Orel's instrument, seems to offer great possibilities, especially when conditions of work and of surface relief are also favourable.

Though primarily adapted to topographical representation, some have tried to adapt photography to large-scale (cadastral) work, and M. J. Gaultier has proposed methods for its employment. But the indoor work of the necessary precision is tedious and costly, so that in a recent paper[1] he proposes for such work an instrument which he names the "topometrographe." This is of the nature of a plane table for precise work, stoutly built and carefully levelled, on which a base-bar is clamped. This carries the pivots of two rulers set at a distance apart corresponding to the base line used. These rulers are set at any desired angle with the base-bar by means of divided circles, and their intersection locates the apex of the triangle. Very considerable accuracy is claimed for the method, which is to be based on a network of third- or fourth-order triangulation; but its effectiveness would appear to be restricted to special cases, where such elaboration in the field is compensated for by economy in the office.

BIRD-NOTES.

FROM the point of view of forest-conservation much interest attaches to Mr. F. E. L. Beal's report on the food of American woodpeckers, published as Bulletin No. 37 of the biological division of the U.S. Department of Agriculture. The report is based on the examination of the contents of a large number of stomachs of sixteen species of these birds; but since the number of specimens examined was much smaller in some cases than in others, it is quite probable that some modification of the order in which these species are tabulated according to the nature of their food may be necessary in the future. Another element of uncertainty in this respect is due to the rapidity with which the vegetable food of the cambium-eating species passes through the stomach.

As the forests of the United States, like those of other countries, have a host of insect enemies, among which wood-boring beetles are pre-eminent, any natural agency that will assist in keeping these pests in check is of the highest value. In the case of wood-boring beetles, woodpeckers occupy the first place as destroyers, and among these the two species of the three-toed genus Picoides are the most valuable. In the typical *P. americanus* no less than 94·06 per cent. of the food consists of animal matter; while as regards its insect-food, 71·05 per cent. consists of beetles and the remainder of ants. Most of these beetles are wood-borers, although a percentage consists of harmless species. Ants also are deleterious to trees, since they often take possession of the borings from which beetles have been extracted by woodpeckers, until they in turn are routed out by these birds. Woodpeckers are frequently charged with inflicting damage on sound trees; but the charge, except in the case of the American group of sapsuckers, is considered to be unfounded. As regards sapsuckers, which feed on cambium, these certainly do inflict damage, which in some cases may be serious although, on the other hand, they consume legions of ants.

The colouring of the Jack snipe forms, according to Mr. F. J. Stubbs in *The Zoologist* for July, an absolutely perfect protective adaptation. In some localities the only means by which the bird can be detected when squatting in its proper haunts is by looking for a couple of curved blades of faded grass of a brighter hue than any indi-

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[1] *Geographical Journal*, June.

[2] *Mitt. d.k.k. geographischen Gesellschaft in Wien*, Bd. 54, No. 4.

[1] *Revue Scientifique*, May 6.

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genous to the district. When detected, such supposed grass-blades are the yellow head-stripes of the snipe. If surprised on a patch of green turf or other inharmonious background, the bird will sometimes run and squat on the mud near a patch of herbage close at hand.

It is announced in the July number of *British Birds*, by Mr. A. H. Meiklejohn, that a breeding colony of fulmar petrels has established itself in Berriedale Head, Caithness, the only other nesting haunt on the mainland being Cape Wrath, Sutherland, which was first discovered to be the resort of these birds in 1901. The most southerly breeding-place in the British Isles is Barra.

Certain erratic lights observed at night on the hillsides at Villierstown ferry, Cappoquin, Ireland, during last winter, by Miss M. E. Dobbs and the local ferryman are tentatively attributed by the former, in an article published in *The Irish Naturalist* for July, to luminous owls, this opinion being based on the assertion of the aforesaid ferryman that the lights are due to birds. In a supplementary article published in the same issue, Mr. C. B. Moffat, after quoting additional testimony to the belief that birds are their source, suggests that these strange luminous emanations may be a form of *ignis fatuus*. It is true that the latter is generally a more flickering type of light, but one resembling Miss Dobbs's description is reported from the Donabate estuary, unless, indeed, the natives mistake a bird for a phantom. But Mr. Moffat goes even further than this, and suggests that the whole story of luminous owls, which, it will be remembered, was first reported by Sir Digby Pigott in a letter to *The Times* for December, 1907, may possibly turn out to be a myth. He notes, however, that an apparently similar luminosity has been attributed to bitterns and certain herons, especially an American species, but states that even this testimony is not definitely accepted by naturalists.

Among the contents of the July number of the Journal of the South African Ornithologists' Union is an article by Mr. C. F. M. Swynnerton on nests and eggs from Mount Chirinda, southern Rhodesia.

IONISATION AND CHARGED SMOKE PARTICLES.

IN the *Sitzungsberichte der k. Akad. der Wissenschaften* of Vienna, vol. 120, part i., Drs. V. F. Hess and G. v. Sensel discuss the results of a series of experiments on the ionisation of the atmosphere made by them during August and September, 1909, on an island separating the two branches of the Danube near Vienna. The observations were made from 9 a.m. to 9 p.m., and the curves for the diurnal variation show marked minima about 5 p.m., both for the positive and for the negative ions. The main object of the authors was to investigate the connection between the ionisation and the meteorological elements, but the period of observation was too short for the conclusions to be regarded as final. The principal results are briefly as follows. For low atmospheric pressure the excess of positive ionisation has double its value at ordinary or high pressures, and a similar difference exists between the values for falling and for rising barometer; the total number of ions, and the number of negative ions, decreases as the temperature increases—a result exactly opposite to that found by Simpson and Gockel: the number of ions is greater for clear than for cloudy sky, especially if the cloud is nimbus: the number of ions is less when the wind comes from the direction of the city; and it is independent of the relative humidity, a result also different from those of Simpson and Gockel, who found that the ionisation decreased as the humidity increased. The recent establishment of systematic observations of the ionisation at some of the principal observatories ought to permit of a fuller discussion of the questions treated in this paper, which will prove valuable in indicating the observations which are specially desirable.

The same number contains a discussion by Dr. K. Przibram of experiments on the charge carried by smoke particles, in the light of Cunningham's correction to Stokes' formula for the connection between the limiting velocity and the radius of the particle. Careful series of experiments on smoke of different substances indicated a definite tendency for the charge to depend on the radius of the particle, and led the author to conclude that the particles could carry charges less than the adopted value for the charge on the negative ion, or that certain factors entered into the motion of charged particles through a gas which had not yet been allowed for. In a note added after the paper had been printed, the author states that owing to a criticism by Regener, he repeated some of the experiments with the plates of his condenser closer together, when he found much less dispersion in the values for the charge. Consequently, the conclusions founded on the earlier experiments may be subject to modification.

HIGH-PRESSURE WATER-POWER WORKS.[1]

THE utilisation of high-pressure water-powers represents the latter portion of the wonderful and rapid development which has occurred in hydraulic works during the last twenty years. Such powers are necessarily situated in mountainous districts, and may be at some considerable distance from thickly populated centres where a demand for power exists. Comparatively low falls were more in use until the question of long-distance high-tension electrical transmission could be looked upon as a sound technical and commercial proposition, and this has only been satisfactorily solved within the last few years.

Hydro-electric stations do not lend themselves very readily to hard-and-fast rules. It by no means follows that what has shown itself to be satisfactory in one case will be equally satisfactory in another. Engineers of every branch are represented in work of this kind, besides surveyors, architects, miners, railroad men, and in some cases geologists and also meteorologists have to be consulted. High-pressure plants usually work out considerably cheaper than low-pressure plants for the same power, but a long transmission line may so increase the capital outlay on the former that a low-pressure station near the consumer is preferable. A very great advantage possessed by high-pressure plants over other types is the readiness with which the irregular flow of rivers may be regulated to supply a constant-power demand by means of storage reservoirs and weirs. The whole rainfall of a district may thus be utilised. Storage, however, increases the cost of a station very considerably. The greater the head of water, the more rational will a storage reservoir be, since the same quantity of accumulated water will represent a proportionately larger store of energy.

Too little attention is usually devoted to the pipe-lines and conduits carrying the water from the lake or river to the turbines. Not a few engineers consider that the pipe-line is a secondary part of a hydraulic power-plant. Pipe-lines are often built by engineers who are experts in the choice of material and in the manufacture of a pipe, but who do not understand the essentially important functions which a complete pipe-line, and especially a high-pressure pipe-line, has to fulfil. The general arrangement, the relative dimensions of different parts of the pipe-line, the methods of anchoring and placing of fixed points, are all such important factors that they can only be properly determined by the turbine builder.

The Necaxa power-station of the Mexican Light and Power Co. is supplied with water under a head of 1312 feet from a reservoir having a capacity of 1590 million cubic feet. The first part of the scheme, commenced in 1903, consisted of the construction of a large earth dam above the falls of the Necaxa River to form the storage reservoir which supplied the power-station with water for about 50,000 horse-power. The dam has a maximum height of 197 feet, length 1279 feet, and greatest breadth at the base 951 feet. An earth dam was selected as the type most suitable for a country periodically liable to earthquakes. Two feeder pipes 6 feet in diameter start from the intake tower in the lake and pass through a tunnel which emerges below the dam wall. These pipes are made of riveted plate, and pass to a receiver pipe which is under a pressure head of 177·8 feet. Six high-pressure pipes descend from the receiver to the power-house. Sluice valves are provided at the receiver to control each pipe, and air pipes are laid from behind the valves on each high-pressure pipe up the hill to a height

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[1] Abstract of a paper read at the summer meeting at Zürich of the Institution of Mechanical Engineers by Mr. L. Zodel, of Zürich.

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